

## The World's Best Practice in Manufacturing

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### Abstract

This paper on the world's best practice in manufacturing discussed in details the concept of Lean Production System (LPS) – a manufacturing approach that is distinct from mass and craft productions. Unlike the mass production that keeps the line moving at all costs but ends up doing massive amounts of rework at the end, Lean production entails spending of more effort upfront correcting problems before they multiply, and ends up with much less total efforts and higher quality in the end. The concept is geared towards turning manufacturing which used to be full of waste of time and resources into a well organized, efficient and more profitable venture. On the critical success factor of LPS implementation, the paper showed that the leadership of a company plays a very prominent role in determining the outcome of its application due to their strategic roles in decision making which will either make or mar the whole exercise. Supplier related problems, market boom losses, non commitment, lack of empowered workforce, and wrongful use of the tools and techniques of LPS by some manufacturing companies are posited as the major impediments and obstacles of the successful implementation of LPS. The work also showed that many manufacturing firms that have adopted the manufacturing approach have continued to considerably increase their market share, as it offers them a competitive advantage and numerous other benefits. These advantages include up to seventy five percent in waste and inventory reduction, increase in production capacity, outstanding decrease in work-in-progress, overall costs, reduction in lead time, overhead cost, and shop floor space, it also increases the quality of products,

throughput, rate of productivity, flexibility, inventory turnover, customer relationship, and profitability.

**Keywords:** Lean production system, throughput, work-in-progress, inventory, mass production

## 1. INTRODUCTION

Lean Production System was originally developed by Toyota Motor Manufacturing Company in Japan, and was then known as Toyota Production System (TPS). This was when the Japanese economy was facing a major decline during the post second world war era. Their manufacturers were seeking for a better alternative that will reposition them for effective competition with the other industrialized nations of the world. According to Jordan and Michel (2001) “the Japanese had to create something out of nothing and do it in a way that would allow them to compete against foreign manufacturers who did have markets sized for mass production success.”

The quest for sustenance led Toyota Motor Manufacturing Company to send the son of the company's director to the then world's most successful auto makers in America. The young man Eiji Toyoda who had an engineering background arrived at the Rouge plant located in Dearborn in order to learn about the secrets of Ford's manufacturing successes. During his stay at the mass production plant, he was able to learn some of the manufacturing techniques being employed by the company. However, due to some factors, which bordered on limited financial and natural resources, the Japanese were unable to adopt the mass production system of manufacturing, as they found it to be both wasteful and unattainable in their environment.

To this end, Toyota Motor Manufacturing Company utilizing the knowledge and ideas they learnt from the western manufacturers, were able to develop a peculiar method of manufacturing, which later became known as Lean Production System. According to Womack and Jones (1996) the Japanese “concluded that the real challenge was to create continuous flow in small lot production when dozens or hundreds of copies of a product are needed, not millions.” The development of Toyota Production System (TPS) took place

between 1945 and 1970 out of necessity, and can be said to be still evolving even up till today.

Notably among the early Japanese that contributed immensely to the development of the manufacturing system include: Taiichi Ohno, Shigeo Shingo and Eiji Toyoda, who explained what he learnt at the Ford's plant to Ohno. According to Thompson (1997), "Taiichi Ohno, Toyota's brilliant Chief Production Engineer designed and developed a new production system which fit the Japanese constraints" He maintained that apart from improving quality, that the new production system which successfully merged mass and craft productions eliminates wastes, and saves space, time cost, as well as other resources.

For efficient utilization of the resources at its disposal, as the company was unable to maintain a very large workforce, Toyota therefore ensured that the workers learnt the use and application of different machines and equipment, which was quite different from Ford's plant where workers were made to continuously work on a specific job all the time. The company also encouraged its workers to increase the quality of their products by the immediate correction of defects whenever they are detected.

Toyota was able to record some profit during the oil scarcity of 1973 because of its application of Lean principles unlike the other manufacturers in Japan. This therefore raised the other companies' curiosity as they began to enquire about the concept which Toyota has been using since 1950, and in no distant future, they all embraced the principles of the new manufacturing approach due to its numerous advantages over mass production.

The western world however became aware of LPS in the early eighties. According to Thompson (1997) the General Motor's partnership with Toyota in California code-named New United Motors Manufacturing Incorporated (NUMMI) in 1984 revealed the Lean Production System to the western manufacturers. A researcher at the Massachusetts Institute of Technology was credited to have coined 'Lean Production', although its concept was invented by Toyota Company. The research enabled Womack, Jones, and Roos to practically inform the world about LPS, through the publication of their book in 1990 titled "The Machine That Changed the World."

The book revealed how Toyota was able to transform itself from an obscure company to the world's leading auto manufacturers due to the application of LPS. In their study Jordan and Michel (2001) observed that "The Machine That Changed the World started many thinking. If LPS could make the Japanese automobile industry so fiercely competitive in cost, time, and quality, then Lean could be a significant approach for any industry."

Although it was generally believed that the concept of LPS originated from Japan through the great efforts of Taiichi Ohno, a school of thought disagreed with it and rather argued that the whole concept of LPS was already been practiced at the Ford Motor Manufacturing Plant for quite a long time. They therefore ascribed its invention to Henry Ford rather than the Japanese. Commenting on this Levinson and Rerick (2002) argued that the Japanese imported LPS from the United States and applied its principle for the manufacture of cheaper automobiles. They maintained that the Japanese were able to achieve this through the reading of Henry Ford's books and should therefore not claim to have invented the concept.

Despite the fact that LPS was originally developed for the automobile industries, today its principles and techniques are being successfully applied to a wide range of industries, and in nearly all the areas of human endeavours, for the elimination of waste and overall improvement. Today, many manufacturing firms that have adopted Lean Production System have continued to considerably increase their market share as it offers them a competitive advantage and numerous other benefits.

## **2. WHY LPS IS REQUIRED**

Manufacturers has over the years come to realise that they could not remain economically viable in the present day market without improving their efficiency and productivity in line with their competitors. To this end, it became evident that this could not be achieved through the traditional system of manufacturing which involves mass production. Therefore to remain competitive in the global market, they have embraced LPS which considerably reduces the cost of manufacturing, as it eliminates the wastes that are associated with mass production, thereby enabling organisations to save lots of money. According to Ohno (1988) the main

aim of LPS is to ensure the improvement of efficiency of production by taking adequate and thorough measures to eliminate wastes.

One of the differences between mass production and LPS according to Womack, Jones and Roos (1990) is that LPS unlike mass production which is wasteful, manufactures a new product while making use of half the efforts of workers, half of the factory space as well as half of overall expenditures. They observed that “mass producers set a limited goal for themselves- ‘good enough,’ which translates into a number of defects, a maximum acceptable level of inventories, a narrow range of standardized products.” While Lean producers “set their sights explicitly on perfection: continually declining costs, zero defects, zero inventories, and endless product variety.”

The main reason why LPS is required by manufacturers is its ability to give a competitive advantage to the users as it enables them to manufacture high quality products faster and also at cheaper rates, this translates into the production of right quantity of goods at the right time and supplied to the customer when they are required. The ability to manufacture products at cheaper rates by Lean manufacturers lies in the system’s approach of zero inspection and zero amount of defects and rework.

Unlike mass production where inventory are stored in warehouses, LPS makes use of ‘kanban’ which entails the keeping of small amounts of inventory at where they are required at the shop floor, thereby ensuring the constant flow of materials, increase in productivity, cost reduction and elimination of wastes.

In his study on why LPS is required, Monden (1983) observed that although that reduction of cost is the system’s major aim, it also enables organisations to achieve the following:

- Quality control: ensures that the system adapts to periodic fluctuations in customer’s demands as regards to the number and varieties of products;
- Quality assurance: ensures that early processes supplies only quality components to the subsequent ones.
- Respect-for-employees: leads to the proper utilisation of human resources to achieve optimum results.

LPS therefore leads to time reduction as well as the manufacture of high quality products that stand the test of time. Commenting on why LPS is preferred by the manufacturers over the traditional mass production Womack, Jones and Roos (1990) pointed out that “the mass producer keeps the line moving at all costs but ends up doing massive amounts of rework at the end, while the Lean producer spends more effort upfront correcting problems before they multiply and ends up with much less total efforts and higher quality in the end.”

### **3. BENEFITS OF LPS**

While highlighting some of the benefits of LPS in his recent survey Carbone (2006) pointed out that “with Lean, a manufacturer carefully reviews his processes and identifies areas of waste.” He indicated that it ensures the reduction in overheads and the level of inventory thereby leading to an increase in the quality of products, as production is made more effective. The application of LPS enables organisations to stop the delivery of large volumes of inventory from their suppliers but rather resort to obtaining them in frequent smaller batches.

Commenting on the benefits of LPS Drew, McCallum and Roggenhofer (2004) concluded that it is the best approach of manufacturing as it does not only lead to quality improvement and reduced production costs, but also ensures the stability of operations while matching ‘supply with demand.’

Some of the typical benefits of Lean Production System as shown in figure 1 include up to seventy five percent in waste and inventory reduction, as well as increase in production capacity.

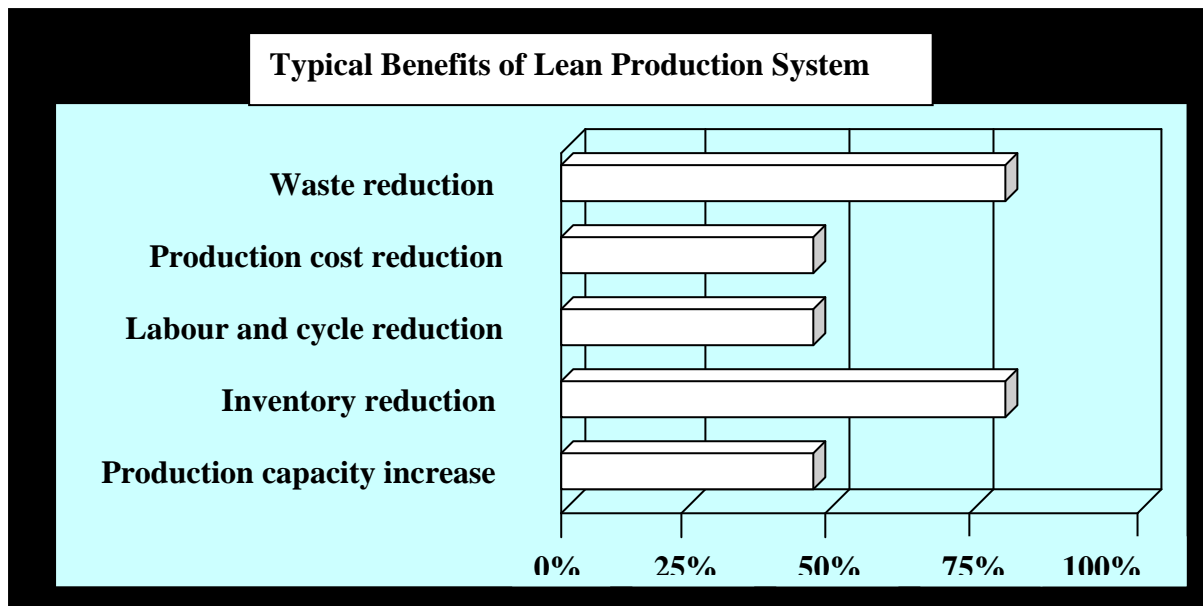


Fig. 1: Typical benefits of LPS (Source: Ventures)  
<http://www.1000ventures.com/presentation/production-systems.html>

Apart from the reduction of waste and increase in the quality and reliability of manufactured products, there are numerous other benefits of LPS as it affects all the facets of any company that adopts it. In their study, Allen, Robinson and Stewart (2001) explained that Lean Production System benefits continue for a very long time after the completion of its implementation. They argued that through the provision of “long time growth and strength, Lean manufacturing is much more than today’s savings – it is a long-term way of doing business that provides continual payback.”

In his study, Kerr (2006) listed the following as the five guidelines of realising the numerous benefits of the processes of LPS.

- Ensure that value is well defined from the customer end’s point-of-view, well divided by product grouping;
- By using Value Stream Mapping ascertain for every product all the processes in the value stream, removing all the non-value adding processes. The value stream entails both the value adding and non-value adding steps and processes that a product undergoes from “concept to launch and from order to delivery”;
- Move the product steadily towards the customer by ensuring that the value adding processes takes place in a harmonised sequence;

- Introduce “flow” and ensure that the customer from the subsequent upstream activity is responsible for value pull; and
- Start the process all over by value definition, value stream steps identification, removal of non-value adding processes and flow and pull introduction. Be consistent to create a perfect value that is devoid of waste.

Some of these benefits include: outstanding decrease in work-in-progress, overall costs, reduction in lead time, overhead cost, and shop floor space, it also increases the quality of products, throughput, rate of productivity, flexibility, inventory turnover, customer relationship, and profitability. Also it is a ‘win win’ situation for any company that adopts and fully implements the manufacturing system as it offers immense benefit to the manufacturer, the employees and the customer.

### **Benefits to the Manufacturer**

There are numerous benefits that a manufacturer that took the wise decision to implement LPS in his company will achieve. These includes: low inventory, which is one of the hallmarks of LPS, it will enable the manufacturer to use the money that would have been tied up in inventory for other purposes.

LPS also results in the long-lasting of machines, it reduces the overhead cost as the manufacturer will have to employ less people in his plant, it ensures that he has a very good working relationship with his happy customers, and it is also an effective tool for the building and maintaining of an effective brand due to the high quality of the manufactured goods, thereby leading to increase in sales, turnover and profitability.

### **Benefits to the Employee**

The application of LPS in an organisation offers immense benefits to the employees, these include: the five-S tool of LPS ensures that shop floors are kept neat and tidy thereby providing a conducive atmosphere for work with little or no accidents, LPS exposes workers to learn different skills, it enhances teamwork where workers can share their views as well as learn from other co-workers, and also it motivates and gives workers a sense of accomplishment as they see the immediate results of their efforts.



According to Cooney (2002) LPS has “facilitated the development of work innovations, such as the delegation of enhanced work responsibilities to empowered teams and the use of job enhancement techniques, such as job rotation, problem solving and employee involvement in continuous improvement activities.”

### Benefits to the Customer

In his study Jones (1990) noted that LPS offers “the customer twice the number of products that only need to be built in half the normal volume per model.” It leads to the manufacturing of improved quality products at faster rates, which is of immense benefit to the customer. It also ensures customer satisfaction through the provision of goods and services when and where they are needed.

### Case Studies

There are many case studies about manufacturing companies that has been successfully implementing the principles of LPS in their firms. They revealed how Lean principles assisted them in the re-positioning of their establishments for better competitive advantage, as well as recorded increase in profitability, among other benefits. Some of these case studies are shown in table 1.

Table 1: Derived benefits of implementing LPS

Company	Lean Production Techniques implemented	Benefits	Source
Osborne Wood Products Inc.	Trained its workforce and started to apply LPS tools and techniques	Reduction in: lead time, inventory and set up time.	Forth (2006)
Oxford Engineering	Introduced Lean improvement techniques	Increase in productivity rose to 16%	Harris (2004)
Semicon Associates	Adoption of continuous improvement and value stream mapping tool, Identification and elimination of wastes.	Increase in the rate of capacity and throughput, operating costs and lead time reduction, and efficiency and quality improvement	Willhite (2004)

Some other companies that also applied the principles of LPS in their establishments as well as the resulting benefits are listed below:

### **Century Furniture:**

In a bid to remain competitive, profitable, and also reposition itself for better customer satisfaction, Century furniture (a high quality furniture manufacturing company) embraced the principles of LPS in its plant. Some of the measures the company adopted according to Russell (2006) were that it succeeded in “moving the upholstery frame assembly area closer to the machining department where frame pieces are cut, cleaning and reorganizing the stock room, and reducing the inventory of cushions from a two-week supply to a one-day supply.”

Within a short time of applying the basic Lean principles, the company was able to achieve “a 30% to 40% improvement in terms of internal quality issues”, reduction in delays in production, better communication among the various departments, and also the creation of additional manufacturing space.

### **DJ Orthopaedics:**

To reverse its dwindling resources and also build a world class drug manufacturing company, DJ Orthopedics according to Vernyi (2005) entrenched the LPS principles by “value-stream mapping, kaizen blitzes, eliminating departments, making the factory visual, streamlining the internal and external supply chain, creating a demand-based scheduling system, implementing a line-of-sight management system and launching a benchmarking program.”



Fig. 2: An employee of DJ orthopedics at work Source: Venyi (2005)

Some of the benefits the company achieved with the application of the above LPS techniques include: steady increase in its annual release of new products, over fifty percent improvement on its delivery performance, increase of sixty four percent in gross profit, seventy percent reduction in injury rate, and the ability to reduce its production lead times from many weeks to few hours. Also as depicted in figure 2, their Lean efforts increased productivity per person to more than 90 percent.

### **The Hon Company:**

According to Panchak (2005), the decision to incorporate LPS techniques into its organization enabled The HON Company to considerably reduce its production cost “as well as increase plant profitability by 27% and reduce an already stellar 22% warranty cost as percent of sales by nearly 32% over three years.”

The company was able to achieve the above results by laying much emphasis on Poka-Yoke or mistake proofing, they started by instilling in the employees the three attributes they require in order to maintain an efficient LPS effort: the ability to recognise processes that need an immediate improvement, the passion to ensure the improvement, and the enablement to embark on the hard work necessary for the improvement.

## **4. CRITICAL SUCCESS FACTORS OF LPS IMPLEMENTATION**

Michel (2005) observed that the success of LPS is highly dependent on proper incorporation of skills and strategy with a principle that promotes Lean production at both inside and outside the shop floor. He identified “flexibility, responsive materials handling and a broad supply chain view” as the major components of Lean success. For an organisation to be successful in its implementation of LPS, it needs to involve all the members of its workforce, as their loyalty and total commitment are very crucial for proper implementation of the manufacturing method.

In his study Schonberger (2000) suggested that in order to make remarkable progress in adopting LPS, a company requires an “environment where workers are empowered, teamwork is encouraged, creativity is fostered, and the complete involvement of all employees is nurtured.” He maintained that this also involves structurally reorganising the firm so as to enhance the “development of multiple career paths within the organization.” Some of the critical success factors for successful implementation of LPS to SMEs include: Leadership, organisational culture, financial capability, expertise and skills, and management.

As shown in figure 3, the leadership of a company plays a very prominent role in determining the outcome of the application of Lean production due to their strategic roles in decision making which will either make or mar the whole exercise. The importance of having a focused leader who is goal oriented in a company that is implementing the manufacturing approach cannot be over-emphasised as he actively participates throughout the process thereby ensuring its full implementation.

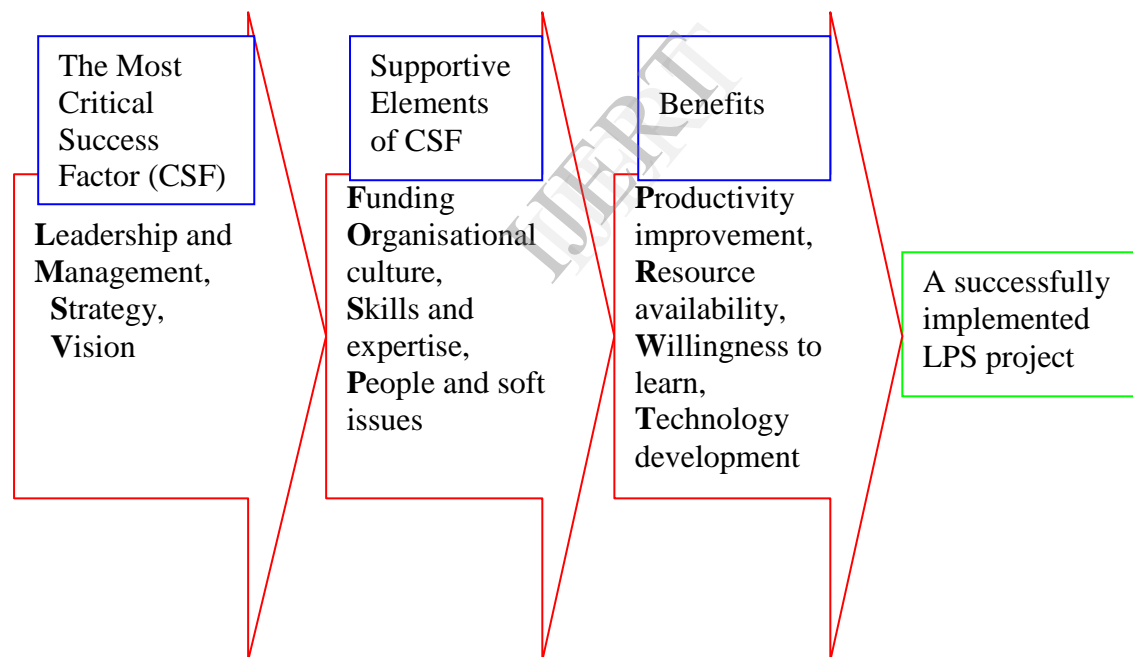


Figure 3: Elements of critical success factors for a successful LPS implementation Source: Achanga and Okogbaa (2006)

Determination and consistency is another very important factor for the successful implementation of LPS in an organisation, as the whole concept is aimed at continuous improvement of all the manufacturing processes. Organisations most times expect an

immediate result the moment they begin implementing the method of manufacturing, which is not always the case as it requires persistence over a long period of time.

Suppliers also play a very prominent role in the success of LPS, this is because the manufacturing method requires the keeping of very low level of inventory and any disruption in it will definitely stop manufacturing processes, thereby leading to losses. To ensure the steady flow of materials, LPS focuses on the maintenance of healthy relationship with the suppliers that will always guarantee the provision of raw materials when they are required. According to Cooper (2002) LPS “takes a broad view of the production and distribution of manufactures, developing a production concept that encompasses the whole manufacturing chain from product design and development, through manufacturing and distribution.”

## **5. BARRIERS AND IMPEDIMENTS TO SUCCESSFUL LPS IMPLEMENTATION**

The inability of some firms to successfully implement the principles of LPS in their organisations can be blamed on some barriers and impediments which they often encounter. Boyer and Sovilla (2003) noted that the major obstacles are wrong estimation of the impacts of principles and management, the wrong impression of progress, inconsistent measures, unprincipled, and the use of LPS as just manufacturing tools instead of a way of engaging in business.

Some of the companies also experience supplier-related problems, as proper implementation of LPS entails the maintenance of minimum amount of inventory, the organisations require effective suppliers that will be able to deliver exact amount of components and raw materials at exactly when they are needed. This therefore constitutes a barrier to LPS implementation as Lean compliant suppliers are often difficult to come by.

Explaining the barriers being faced by some manufacturing companies in the implementation of LPS, the UK Lean Aerospace Initiative (LAI) indicated on their website that the manufacturing method has not achieved a sustainable and considerable result in the UK small

and medium-sized enterprises as a result of some hurdles which include “lack of knowledge of what Lean can do for them; the misconception that ‘Lean is for large companies only’; their inability to access support resources; and their inability to afford tailored training.”

The setting up of LPS in a company most times is quite difficult as it involves an enormous amount of money; this is because all the manufacturing systems need to be completely overhauled. The cost of implementation arises as a result of setting up of cell manufacturing plant, trainings, and other logistics which are the pre-requisite for an efficient introduction of LPS. This explains why some firms are still applying the traditional system of manufacturing.

In his study Nicholas (1998) listed the following as some of the barriers and impediments of implementing LPS:

- Dissipating energy and efforts in solving the inconsequential problems facing an organisation and ignoring the few that are very crucial;
- Focus on “internal processes” to the detriment of customer oriented results;
- Inadequate reforms and emphasis on short term benefits;
- Unfocused and irrelevant trainings; and
- Lack of coordinated team work.

Furthermore, most leadership and management of companies also constitute barriers to successful introduction and implementation of LPS to their establishments, as they fear that it may end up aggravating the problems already inherent in their system rather than getting them solved, this is as a result of their belief that the successes recorded by the manufacturing approach in Japan could be attributed to the Japanese culture.

Also, non commitment, lack of empowered workforce, and wrongful use of the tools and techniques of LPS by some manufacturing companies that has already adopted the manufacturing method in their firms are other impediments in the successful implementation of LPS.

## 6. STRENGTHS AND LIMITATIONS OF LPS

The high rate at which many manufacturing companies has been adopting the principles of LPS over the years could be attributed to the numerous advantages it has over the traditional or mass production system of manufacturing. However, the system also has some limitations as shown in table 2, although the strengths far outweigh it.

Table 2: Strengths and limitations of LPS

<b>STRENGTHS OF LPS</b>	<b>LIMITATIONS OF LPS</b>
Waste Elimination	High set up cost
Increases productivity and quality of products	Supply chain Risk
Enhances profitability	Market boom losses
Production of high quality products	Requires highly skilled workforce
Inventory and Work-in-Progress reduction	Production stoppages due to suppliers' failures
Reduces lead time/Time to market	
Enhances production flexibility	
Reduces Production cost	
Creates conducive working environment	
Increases throughput	
Enhances customer service	
Reduces cycle time	

Just like every other facet of human endeavour, there are some limitations in the application of LPS by manufacturing companies which sometimes threaten its successful implementation. As the manufacturing approach was originally designed by the Japanese, many companies that have been practicing the traditional system of manufacturing for a long time often find it difficult to fully adapt to the new manufacturing approach which focuses on completely different manufacturing concept.

The introduction of LPS requires enormous changes both in terms of physical structures and working conditions. However, as human nature resists change, the employees overall performance are often hindered as a result of emotional resistance. Also rational resistance most times inhibit the workers to perform at their optimum best which often results when they are not properly trained on the applications of the new manufacturing method. This is usually noticed in organisations whose entrenched culture is centred on mass production as the workers find it very difficult to understand the rationale behind the keeping of very low inventory.

The expectations that the employees would tackle problems in a predetermined manner is a major limitation of LPS as it does not encourage the workers to use their initiatives which may sometimes be a better approach in fixing a particular problem. Another limitation encountered by some firms in the implementation of LPS is the issue of highly skilled workforce, this is because for the method to be flexible it requires multi-skilled employees that will be able to adapt to different situations that are bound to arise.

Companies that adopt the Lean Production System of manufacturing often encounter problems with their suppliers; this is because the manufacturing approach is geared towards the maintenance of a minimum level of inventory. Any delay or disruption from the suppliers often leads to losses which sometimes run into thousands of pounds, as manufacturing has to be shut down pending the supply of the required materials. This is because organisations that adopt the manufacturing approach have little or no inventory to rely on.

One of the tools and techniques of LPS is known as Just-In-Time, this has to do with manufacturing only the amount of goods required by the customers at the time they want it. As they produce to order, companies that apply the principles of LPS virtually has no finished products in their stocks, as a result of this their competitors always capitalise on this to sell all their products in stock whenever there is a market boom due to an instant increase in the demand of products.

In LPS, waste (muda) is seen as anything that destroys resources and do not add value to the finished product. The concept is geared towards turning manufacturing which used to be full of waste of time and resources into a well organized, efficient and more profitable venture. As shown in figure 4, the seven wastes that LPS battles to eliminate are over-



production, inventory, motion, waiting, transportation, over-processing, and defects. However, over the years the number of wastes has been increased to eight as it has been realized that the inability to meet the customer's requirements can also be considered as a waste, the eight wastes has come to be known in LPS as the 7+1 wastes.

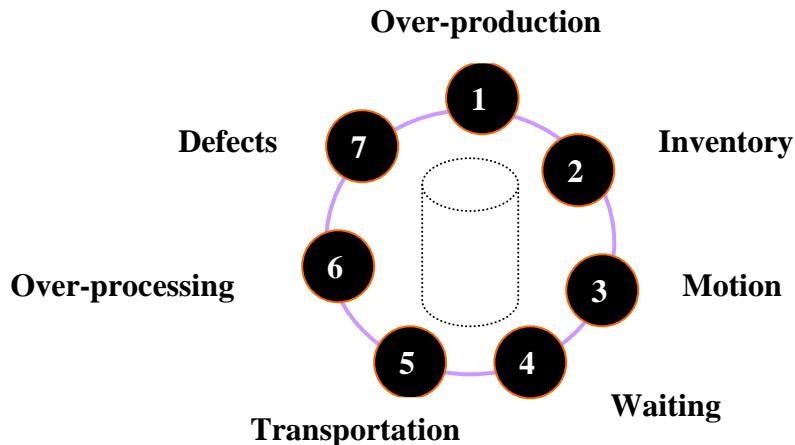


Fig. 4: The seven wastes Source: Beyondlean, <http://www.beyondlean.com/history-of-lean.html>

It has been observed that the two biggest wastes inherent in manufacturing are the queuing of materials and over-production. According to Page (2004) “eliminating overproduction reduces work in progress, and in doing so makes the system more responsive, complacency about rejects is reduced and valuable resources are not wasted on product that has no immediate sales value.” She also stated that unnecessary queue of inventories results when efforts are made to maximize the overall efficiency of individual operating parts, thereby leading to increase in lead time and over spacing of operations that ought to be very close.

Some of the strengths of LPS include the reduction of: waste, lead time, inventory, cycle time, and production cost, it also increases profitability, throughput and flexibility, thereby resulting to customer satisfaction.

The implementation of LPS techniques by manufacturing companies highly increases their productivity because of the elimination of wastes and reduction in inventory. Also due to the increase in the quality of products, companies that apply the manufacturing principle spend little or no resources correcting defective products. According to Page (2004) some of the reasons for increase in productivity when a company implements LPS include:

- The waste of little or no time while searching for equipment and tools as a result of proper house-keeping.
- The reduction in the waste of time while waiting for inventory to arrive.
- The reduction of time wasted in moving parts and equipment in the manufacturing floor
- The ability to perform some works in machinery cycles due to the nearness of the consecutive operations.

The adoption of the techniques of LPS makes manufacturing highly profitable as a result of fast manufacturing of goods and products; also the considerable reduction in lead times and production costs also enable organizations to immediately sell their products, beat their competitors and also increase the rate of turnover, thereby maximizing profit.

Other factors that contribute to increase in profit in LPS include: low inventory, continuous flow of work, waste elimination, and little or no manufacturing support processes.

## **7. WHAT THE FUTURE HOLDS FOR LPS**

The success of LPS in the future from many indications is very bright as it is fully dependent on continuous improvement breakthroughs being made by the present implementers.

With the numerous achievements recorded by Lean-complaint firms in the application of LPS in their companies, the general belief is that all firms must have adopted the manufacturing principle. However, not all the organizations are currently fully implementing the entire principles of LPS as many of them are just implementing few aspects of it. In the future, the manufacturing approach will keep on gaining more acceptances and will subsequently result in all the manufacturing companies adopting and implementing total LPS principles with all the tools and techniques working harmoniously.

The manufacturing strategy will later become a household name in manufacturing as companies continue to record successes from its numerous benefits, by ensuring that their manufacturing strategy is in line with their corporate strategy. This will therefore lead to very

dynamic and competitive companies where emphasis and competitive advantage will shift from meeting the customer's needs to exceeding his requirements.

## ABSTRACT

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